INDUSTRIAL ICs

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Icon Guide

Motor Control
Process Control
Instrumentation
Building Automation
Energy
Security

Industry's First DAC with Dynamic Power Control Optimizes Thermal Management in Multichannel Industrial Control Applications

The density of today's factory process control systems is reaching levels where power consumption and thermal issues are beginning to undermine equipment performance, reliability, and safety.

Solution

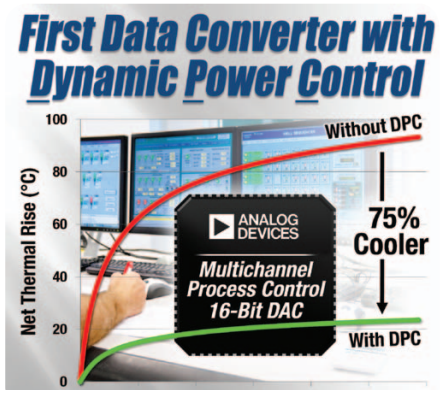
ADI's highly integrated AD5755 data converter is a complete multichannel control integrated circuit (IC) that incorporates four precision 16-bit DACs with programmable voltage or 4 mA to 20 mA output drivers, along with dynamic power control. The dynamic power control feature works by continually sensing the load impedance and delivering only the required power to the load, thus minimizing power loss in the rest of the system. This feature reduces self-heating and temperature elevation in dense, multichannel system racks. The unparalleled combination of features and performance found in the AD5755 enables up to 4× more terminals at twice the performance in a single analog I/O module. Compared to other driver technologies available today, the AD5755 lowers power consumption by up to 80% and net thermal rise (silicon temperature minus ambient temperature) by 75%.

The 16-bit AD5755 offers a full-channel specification with a maximum total unadjusted error of 0.05% and a relative accuracy of ±0.003% max and does not require system calibration, which shortens development time and reduces system maintenance costs. In addition, the single chip architecture combines multiple converter, power management, linear, and other functions, increasing mean time-to-failure (MTTF) and improving reliability. Also included are various diagnostics for real-time fault analysis, including communication, connection, and interface alerts, which simplify the design task and boost operational up-time. The AD5755 supports standard industrial voltage and current output ranges and can be used with standard highway addressable remote transducer (HART) protocol modems. Also integrated on chip is a 5 ppm/°C internal reference, user-accessible offset and gain registers, and a 30 MHz serial peripheral interface (SPI) compatible interface.

AD5755 Features*

- Quad DAC with 16-bit resolution and monotonicity
- Dynamic power control for thermal management
- Relative accuracy of ±0.003% max, with no system calibration required
- Integrated on chip is a 5 ppm/°C internal reference
- Temperature range: −40°C to +105°C
- 9 mm × 9 mm, 64-lead LFCSP
- Pricing:
  - AD5755—$13.35

*This product is in sampling stage, with full production at a later date. Samples can be obtained by visiting the product page on *www.analog.com*.



Applications

- Process control
- Actuator control
- HART networks

MAKEADIFFERENCE

ANALOG DEVICES

Enhancing Connectivity and System Efficiency in Remote Industrial Applications

In smart transmitter applications, there is a need to remotely measure gas, light intensity, flow rate, and temperature, etc., as well as transmit data via the industry-standard 4 mA to 20 mA loop, all within a limited power budget. This need makes the optimization of the available power budget one of the primary challenges facing system designers. To meet these requirements, system designers require a loop interface solution that is compact, power efficient, and highly accurate.

Solution

The AD5421, a complete transmitter solution, combines a precision 16-bit, loop-powered digital to 4 mA to 20 mA transmitter with on-board voltage regulation circuitry. The regulator generates a user-programmable 1.8 V to 12 V output voltage designed to power the AD5421 and the peripheral components within the smart transmitter. Consuming only 250 μA of quiescent current, the AD5421 conserves the system power budget enabling the selection of more accurate, higher power sensor electronics. Housed in a 28-lead TSSOP and 32-lead LFCSP (5 mm × 5 mm), the AD5421 offers a complete single chip solution that reduces the overall PCB component count, providing 55% footprint saving over alternative solutions. The AD5421 offers high end performance specifications with high linearity (0.0015%), low drift (5 ppm), and excellent TUE (0.05%) performance. By improving the accuracy and repeatability of smart transmitters operating in harsh environments, the AD5421 offers an ideal solution to drive system efficiency. The AD5421 can be used with standard HART protocol circuitry and offers NAMUR-compliant output ranges.

DAC and Transmitter IC for Loop-Powered Applications
ANALOG DEVICES
16-Bit DAC
• 4mA to 20mA transmitter
• Intelligent power management

AD5421 Features*

- 16-bit resolution and monotonicity
- Output ranges: 4 mA to 20 mA, 3.8 mA to 21 mA, 3.2 mA to 24 mA
- On-chip fault alerts via FAULT pin or ALARM current
- Loop voltage range: 5.5 V to 52 V
- On-chip reference (5 ppm/°C max)
- 5 mm × 5 mm, 32-lead LFCSP; 28-lead TSSOP
- Pricing:
  - AD5421—$4.52

*This product is in sampling stage, with full production at a later date. Samples can be obtained by visiting the product page on *www.analog.com*.

Applications

- Industrial process control
- 4 mA to 20 mA loop-powered transmitter
- Smart transmitter

Software-Programmable Current and Voltage Output Drivers Bolster Industrial and Process Control System Flexibility and Performance

Programmable logic controllers, factory automation, and industrial control systems measure a variety of process variables that must be reliably communicated via a 4 mA to 20 mA current loop or controlled with a bipolar voltage. These requirements are coupled with the need for low cost, high performance, programmable analog drivers that can be tailored for each system design requirement.

Solution

The AD5748 and AD5749 are complete, programmable, single-channel analog output drivers, which eliminate the need for additional external components, like shunt resistors or range selection resistor networks. These drivers take the analog output from a discrete low voltage, single-supply DAC, like the AD566x *nano*DAC® family, and condition it to provide the desired loop output. Designed to meet the communication needs of highly configurable industrial automation controllers, the AD5748 offers a user-programmable current and voltage output. The AD5749 provides a software- or hardware-programmable current output. The AD5748 and AD5749 offer best-in-class performance specifications with TUE accuracy of ±0.2% FSR and full-scale drift of ±2 ppm/°C over the full operating temperate range and enable the realization of high performance cost-efficient systems. ADI's complete portfolio of foot-print- and software-compatible output drivers offers designers an easy to use, flexible solution that facilitates the development of reliable, cost-efficient process control equipment.

AD5748/AD5749 Features

- AD5748 current ranges: 4 mA to 21 mA, 0 mA to 21 mA; voltage ranges: 0 V to 5 V, 0 V to 10.5 V, ±10.5 V
- AD5749 current ranges: 0 mA to 24 mA, 4 mA to 20 mA
- On-chip output fault detection
- 5 mm × 5 mm, 32-lead LFCSP

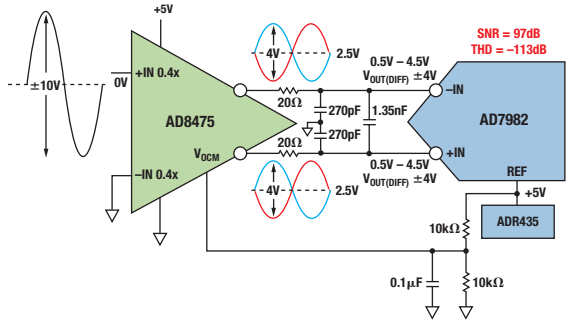
Differential Amplifier Drives 18-Bit, 2 MSPS SAR ADC with ±10 V Inputs at Gains Less than 1 V/V

In industrial, instrumentation, and medical applications, engineers face a common problem where high voltage signals (for example, ±10 V, ±5 V) have to interface with precision low voltage ADCs. The AD8475 is the first attenuating differential amplifier that offers precision gains of 0.4 and 0.8, for differential inputs up to ±10 V at the single 5 V power supply. Now engineers can use a single part with selectable attenuating gains and level-shifting to drive low voltage, high precision, differential input SAR ADCs in high voltage applications, saving board space and system power with ease of use. A high impedance input sets the output common-mode voltage. Impressive performance specifications, such as 10 nV/√Hz output noise, 100 MHz bandwidth, and a 50 V/μs slew rate, make the AD8475 capable of driving 18-bit ADCs up to 2 MSPS with 8 V p-p input range, including ADI's PulSAR® AD7986 18-bit, 2 MSPS, 15 mW ADC in QFN; AD7641 18-bit, 2 MSPS SAR ADC; AD7622 16-bit, 2 MSPS differential ADC; and AD7982 18-bit, 1 MSPS PulSAR 7 mW ADC in MSOP/QFN. With low distortion (110 dB THD + N), the AD8475 is also suitable for driving high speed Σ-Δ ADCs. Its low power dissipation of 3 mA quiescent current makes it suitable for portable applications.

AD8475 Features

- Flexible gains and level shift
- Robust overvoltage protection up to ±12 V
- Power supply: 3 V to 10 V or ±1.5 V to ±5 V
- Differential output designed for modern ADCs
- Suited for driving 18 bits for up to 4 MSPS converter
- 3 mm × 3 mm, 16-lead LFCSP; 10-lead MSOP
- Pricing:
  - AD8475—$2.60

Attenuating Differential ADC Driver



Applications

- ADC driver
- Line driver
- Differential instrumentation amplifier
- Single-ended-to-differential converter
- Differential-to-single-ended converter

16-Bit Σ-Δ ADC Enables Portable and Battery-Powered Precision Instrumentation

Increasingly, battery-powered instrumentation applications are demanding a low cost, low power, precision ADC solution, but they cannot tolerate any compromises on performance.

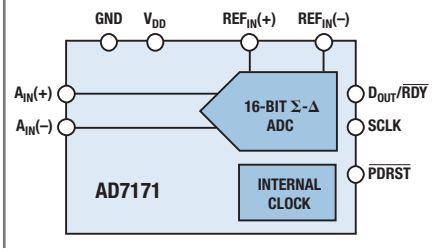
Solution

The AD7171 16-bit Σ-Δ ADC with on-chip oscillator addresses this requirement. Consuming only 110 μA of supply current, this device provides a simple way to add monitoring and diagnostic functions to portable instrumentation equipment in industrial process controls, medical monitoring devices, and other applications that require reliable, highly accurate signal conversion on a tight power budget within a confined printed circuit board area. The AD7171 is easily incorporated into designs—and with no registers to program and a fixed output data rate, it provides a simple way to add precision measurement to a design. The device achieves 16-bit noise-free resolution, meeting the demanding performance specifications of equipment used to precisely monitor patient vital signs and measure real-world instrumentation phenomena, such as pressure and temperature. A 12-bit version (the AD7170) is also available.

AD7171 Features

- INL: ±0.4 LSB at 16 bits
- Power consumption: 110 μA (5 μA in power-down mode)
- Ease of use, fixed sampling rate; no programming required
- On-chip oscillator
- Temperature range: –40°C to +105°C
- 3 mm × 3 mm, 10-lead LFCSP
- Pricing:
  - AD7171—$1.15

AD7171 Block Diagram



Applications

- Portable instrumentation
- Temperature measurement
- Pressure measurement
- Industrial process control

Fourth Generation *i*Sensor IMU Brings Superior Performance and Ease of Implementation to Complex Inertial Sensing Applications

Accurately sensing motion on three axes to provide either navigation or stabilization control to industrial platforms requires tight tolerance over temperature drift, vibration influence, sensitivity variance, and mechanical alignment. Designing a high performance MEMS inertial measurement unit (IMU) involves the integration of hundreds of components, complex signal processing design, and time consuming innovation in multiaxis, multisensor calibration.

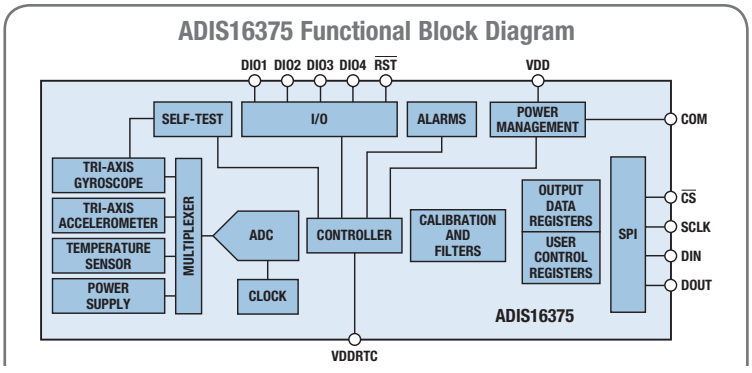
Solution

The ADIS16375 *i*Sensor® IMU provides the industry's highest performance and most integrated six degrees of freedom sensor, improving on previous generations by better than 2×. A unique multicore architecture eliminates the influence of vibration, and fully embedded high speed sensor processing provides increased sampling rates, improved Kalman filtering, and additional data output options and features.

ADIS16375 Features*

- Dynamic range: ±300°/sec, ±18 *g*
- Wide bandwidth: 330 Hz
- Fast start-up: 300 ms
- High sample rate: 2460 SPS
- Single-supply operation: 3.3 V
- Programmable filtering and diagnostics
- 44 mm × 47 mm × 14 mm
- Pricing:
  - ADIS16375—$650.00

*ADI offers a broad portfolio of high performance sensor and integrated sensor and signal processing solutions to meet design requirements and business strategy. Visit *www.analog.com/MEMS*.



Applications

- Precision instrumentation
- Industrial vehicle navigation
- Platform stabilization and control
- Medical instrumentation/navigation
- Robotics

Enhanced Accurate Signal Processing in Instrumentation Applications

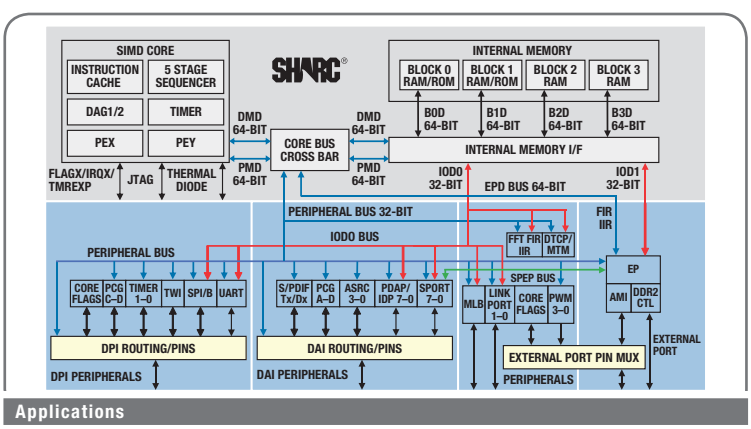
Greater accuracy in computation is enabled by the use of a floating-point digital signal processor that supports a 32-bit or 40-bit extended precision format. Additionally, the need to move greater amounts of data into and out of the compute engine necessitates a higher speed and, thus, higher bandwidth memory. The need for more processor engines or FPGAs also requires a high speed interface to allow this multiprocessor connectivity.

Analog Devices' SHARC® ADSP-21469 offers one of the highest performance 32-bit/40-bit extended precision floating-point DSP solutions in the marketplace today. The device boasts a core speed of 450 MHz, up to 5 MB of on chip-memory, and a 16-bit wide DDR2 external synchronous memory. The ADSP-21469 has a 16-bit wide DDR2 memory interface with 450 MHz data rate, as well as an asynchronous memory interface. The ADSP-21469 has two link ports that are eight bits wide and can operate up to 166 MHz. The SHARC ADSP-21469 has true floating-point capability and can operate in both commercial and industrial temperature environments. This SHARC device also has integrated peripherals such as UARTs, 2-wire interface, eight serial ports, and precision clock generators.

ADSP-21469 Features

- Up to 450 MHz SHARC processor
- 5 MB of on-chip RAM
- 16-bit wide DDR2 external memory interface
- Two 8-bit wide 166 MHz (max) link ports
- Integrated I/O peripherals such as serial ports, UARTs, PCGs
- Pricing:
  - ADSP-21469—$34.20*

*Price is subject to change.



Applications

- Instrumentation
- Motor control
- Factory automation
- Electronic test and measurement

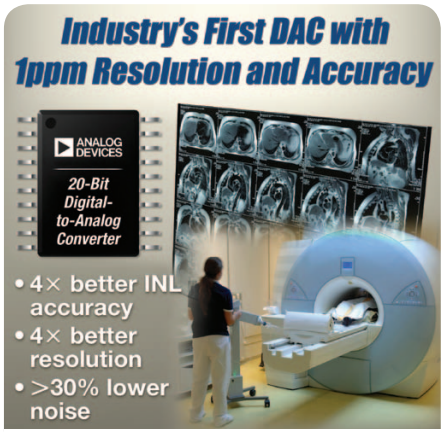
Breakthrough 1 PPM Digital-to-Analog Converter Improves Precision Instrumentation Design Capabilities

In a host of precision instrumentation applications, researchers and product developers require greater levels of accuracy and repeatability to excite, position, or actuate various control parameters. Previously, 1 part per million (ppm) system design tasks entailed expensive and cumbersome implementations involving multiple lower resolution DACs with a significant number of discrete components and support ICs.

Solution

The AD5791 is the industry's first single chip DAC to feature true 1 ppm resolution and accuracy, providing 4× greater accuracy and 4× more resolution than competing converters. The 20-bit AD5791 offers a relative accuracy specification of ±1 ppm INL maximum, and operation is guaranteed monotonic with a ±1 ppm DNL maximum specification. The product delivers 0.025 ppm low frequency noise, 7.5 nV/√Hz noise spectral density, 1 µs settling time, and 0.05 ppm/°C output drift. In addition, the device features sub-1 ppm lifetime drift. The output can be configured for standard unipolar (5 V, 10 V) or bipolar (±5 V, ±10 V) output ranges. The AD5791 uses a versatile 3-wire serial interface that operates at clock rates up to 35 MHz. The AD5791 DAC incorporates a power-on reset circuit that ensures the DAC output powers up to 0 V and in a known output impedance state and remains in this state until a valid write to the device takes place.

In electronic test and measurement systems, this device improves signal quality and repeatability, enables precision control and positioning, and improves the probability of repeatable measurement. The low noise, low drift, and fast refresh rate of the device maximize operational up-time by eliminating costly calibration cycles and enable faster system response time, thereby reducing cost of test.


Industry's First DAC with 1ppm Resolution and Accuracy
ANALOG DEVICES
20-Bit Digital-to-Analog Converter
• 4× better INL accuracy
• 4× better resolution
• >30% lower noise

Applications

- Medical instrumentation
- Test and measurement
- Industrial control
- Chemical analysis
- Galvanometer scanners

AD5791 Features

- 20-bit resolution
- 1 ppm linearity without adjustments
- 1/f noise: <0.1 ppm peak-to-peak noise
- Noise spectral density: 7.5 nV/√Hz
- Low temperature drift: 0.05 ppm/°C
- Long-term stability: <1 ppm
- Fast 1 µs settling time
- Temperature range: –40°C to +125°C
- 20-lead TSSOP package
- Pricing:
  - AD5791—$37.86

Web-Based Tools

Design and Simulation Tools Library

Quickly and easily navigate the ADI library of design and simulation tools grouped by the technology that they support at *www.analog.com/tools*.

Technical Document

The 20-Bit DAC is the Easiest Part of a 1 ppm Accurate Precision Voltage Source. View this issue of *Analog Dialogue* at *www.analog.com/analogdialogue_1ppm*.

Webcast Series

Designing for 1 ppm Voltage Source Accuracy at *www.analog.com/onlineseminars*.

Video

View the latest AD5791 20-bit DAC video online at *www. analog.com/AD5791_video*.

Industrial ICs Selection Guide

Industrial PLC DAC Output Drivers

Part Number	Output Type	Voltage Range (V)	Input Range (mA)	Input Voltage Range (V)	Description	Price ($U.S.)
AD5750	Voltage or current	0 to 5, 0 to 10, ±5, ±10 with 20% overrange	4 to 20, 0 to 20, 0 to 24, ±20, ±24 with 2% overrange	0 to 4.096	Bipolar current and voltage output driver with programmable ranges and analog input range 0 V to 4.096 V	2.45
AD5748	Voltage or current	0 to 5, 0 to 10.5, ±10.5 with 20% overrange	4 to 21, 0 to 21 with 2% overrange	0 to 4.096	Current and voltage output driver with programmable ranges and analog input range 0 V to 4.096 V, 24 V compliance	2.15
AD5749	Current	N/A	0 to 24, 4 to 20 with 2% overrange	0 to 4.096	Unipolar current output driver with programmable ranges and 55 V compliance	1.80

Integrated PLC DACs

Part Number	Channels	Resolution (Bits)	Output Type	Input Range (mA)	Voltage Range (V)	Description	Price ($U.S.)
AD5421	1	16	Current	4 to 20, 3.8 to 21, 3.2 to 24,	N/A	16-bit, loop-powered, 4 mA to 20 mA DAC driver with intelligent power management	4.52
AD5755	4	16	Voltage or current	0 to 20, 4 to 20, 0 to 24	0 to 5, 0 to 10, ±5, ±10, ±6, ±12	Quad-channel, 16-bit, 4 mA to 20 mA, voltage output DAC with dynamic power control	13.35
AD5735	4	12	Voltage or current	0 to 20, 4 to 2, 0 t0 24	0 to 5, 0 to 10, ±5, ±10, ±6, ±12	Quad-channel, 12-bit, 4 mA to 20 mA, voltage output DAC with dynamic power control	9.85
AD5757	4	16	Current	0 to 20, 4 to 20, 0 to 24	N/A	Quad-channel, 16-bit, 4 mA to 20 mA current output DAC with dynamic power control and HART connectivity	13.47

Σ-Δ ADCs

Part Number	Resolution (Bits)	A_{IN} Channels	Minimum Input Range (V)	Maximum Input Range (V)	Peak-to-Peak Resolution @ Max Input Range		Power Supply Current Typical (mA)	On-Chip PGA	On-Chip A_{IN} Buffer	Features	Price ($U.S.)
					Resolution (Bits)	@ Data Rate (Hz)					
AD7170	12	1		$\pm V_{REF}$	12	125	0.11	N/A	N/A	Low power	0.95
AD7171	16	1		$\pm V_{REF}$	16	125	0.11	N/A	N/A	Low power	1.15
AD7193	24	4	$\pm V_{REF}/128$	$\pm V_{REF}$	22	4.7	4.65	•	•	Low noise/ 4 kHz max update rate	5.40
AD7194	24	8	$\pm V_{REF}/128$	$\pm V_{REF}$	22	4.7	4.65	•	•	Low noise/ 4 kHz max update rate	6.95

Inertial Measurement Units (IMUs)

Part Number	Measurement Range (°/sec)	In-Run Bias Stability (°/sec)	Typical Bandwidth (kHz)	Supply Voltage (V)	Supply Current (mA)	Temperature Range (°C)	Package (Module) Size	Price ($U.S.)
ADIS16362	±75 to ±300, ±1.7 *g*	0.007	0.33	4.75 to 5.25	49	–40 to +105	23 mm × 23 mm × 23 mm	336.00
ADIS16367	±300 to ±1200, ±18 *g*	0.013	0.33	4.75 to 5.25	49	–40 to +105	23 mm × 23 mm × 23 mm	403.00
ADIS16375	±75 to ±300, ±18 *g*	0.0035	0.33	3.3	225	–40 to +85	44 mm × 47 mm × 14 mm	650.00
ADIS16385	±75 to ±300, ±5 *g*	0.0017	0.33	4.85 to 5.15	132	–40 to +105	36 mm × 47 mm × 39 mm	869.00
ADIS16405	±75 to ±300, ±18 *g*, ±2.5 gauss	0.007	0.33	4.75 to 5.25	70	–40 to +105	23 mm × 23 mm × 23 mm	412.00

Amplifiers

Part Number	CMV (V)	Typical BW (kHz)	Minimum CMRR (dB)	Supply Voltage (V)	Temperature Range (°C)	Gain (V/V)	Maximum Supply Current (mA)	Price ($U.S.)
AD8273/ AD8274	3 ($-V_S$ + 1.5) to 3 ($+V_S$ – 1.5)	20,000	77	±2.5 to ±18	–40 to +85	0.5/2	2.5	1.05 1.67
AD8276/ AD8277	–2 (V_S + 0.1) to +2 (V_S – 1.5)	550	86	±2 to ±18	–40 to +85	1	0.2	0.95 1.60
AD8278/ AD8279	–3 (V_S + 0.1) to +3 (V_S – 1.5)	1000	80	±2 to ±19	–40 to +85	0.5/2	0.2/0.3	0.95 1.60
AD8208/ AD8209	–2 to +45	70/80	80	4.5 to 5.5	–40 to +125	20/14	2	1.67
AD8217	4.5 to 80	500	90	4.5 to 80	–40 to +125	20	2	0.80

Voltage Regulators

Part Number	Device Type	Input Voltage Range (V)	Output Voltage (V)	Output Current (mA)	Temperature Range (°C)	Package	Price ($U.S.)
ADP1720	LDO	4 to 28	3.3, 5.0, adjustable	50	–40 to +125	8-lead MSOP	0.41
ADP3303	LDO	3.2 to 12	2.7, 3.0, 3.2, 3.3, 5.0	200	–20 to +125	8-lead SOIC	1.35
ADP7102/ ADP7104	LDO	3.3 to 20	1.5, 1.8, 2.5, 3.0, 3.3, 5, 9, 12, 15, adjustable	300/500	–40 to +125	8-lead LFCSP, 8-lead SOIC	1.75 2.03
ADP2300/ ADP2301	Regulator	3.0 to 20	Adjustable down to 0.8	1.2 A	–40 to +125	6-lead TSOT	1.02 1.02
ADP2302/ ADP2303	Regulator	3.0 to 20	Adjustable down to 0.8	2 A/3 A	–40 to +125	8-lead SOIC EP	1.12 1.50
ADP1828	Controller	3.0 to 20	Adjustable down to 0.6	Up to 25 A	–40 to +125	20-lead QSOP	1.52
ADP1829	Dual controller	3.0 to 20	Adjustable down to 0.6	Up to 2 × 25 A	–40 to +125	32-lead LFCSP	2.13

Digital Isolators

Part Number	Description	Insulation Rating (kV rms)	Data Rate	Input Supply Range (V)	Maximum Temperature (°C)	Package	Price ($U.S.)
ADuM120x	Dual-channel digital isolator	2.5	1, 10, 25	3.0 to 5.5	105	16-lead SOIC_W	1.22
ADuM3160	USB 2.0 compliant digital isolator	2.5	Low speed to 1.5 Mbps, full speed to 12 Mbps	3.0 to 5.5	105	16-lead SOIC_W	3.13
ADuM5000	*iso*Power® dc-to-dc converter	2.5	N/A	3.0 to 5.5	105	16-lead SOIC_W	3.16
ADuM744x	Quad-channel digital isolator	1	1, 25	3.0 to 5.5	105	16-lead QSOP	1.50

Isolated RS-485 Transceivers

Part Number	Insulation Rating	Full Duplex	Half Duplex	Maximum Data Rate	Integrated *iso*Power	Power Supply (V)		Maximum Temperature (°C)	Package	Price ($U.S.)
						Logic Side	Bus Side			
ADM2587E	2.5	•	•	500 kbps	•	3.0 to 5.0	N/A	85	20-lead SOIC_W	5.50
ADM2582E	2.5	•	•	16 Mbps	•	3.0 to 5.0	N/A	85	20-lead SOIC_W	6.50

Analog Microcontrollers

Part Number	Core	Memory Flash/SRAM (kB)	Key Peripherals	Package	Price ($U.S.)
ADuCRF101	M3	128/16	Sub-1 GHz radio	9 mm × 9 mm, 64-lead LFCSP	4.49
ADuC7023	ARM7	62/8	12-bit ADC/DACs × 4	5 mm × 5 mm, 32-lead LFCSP	2.98
ADuC7124/ADuC7126	ARM7	128/32	12-bit ADC/DACs × 2/ DACs × 4	9 mm × 9 mm, 64-lead LFCSP	5.95

Motor Efficiency Begins with the Processor

Enhancements in processor technology that balance the price/performance ratio have had a positive impact on the adoption of sophisticated motor control designs in high volume applications. Leveraging these enhancements with ADI's Blackfin and SHARC processors enables a better controller and control scheme, pushing the efficiency of motor control to nearly 100%.

Within the industry, there is no doubt that the enhancement of multiple observer models running real-time model-based estimators will help to enhance performance of the drive, the system efficiency and topology, and the deployment method of the design. In regard to the deployment method of the design, graphical systems like MATLAB®/Simulink® are capable of easing the design flow and enhancing the development of new algorithms. With these tools—and the link to the executing processors—it becomes clear that a more complex deployment can be achieved. Processor-level enhancements centric to core speed, analog-to-digital conversion resolution, and memory integration will afford designers the capability and precision to achieve greater quality/performance objectives while accelerating time to market.

With the recent introduction of ADI's Blackfin ADSP-BF50x series of digital signal processors, significant processing performance gains have been achieved in parallel with price point reductions to bring DSP caliber performance to motor control applications previously serviced by performance constrained processors and microcontrollers. Motor system designers will leverage this performance profile to achieve greater system functionality and precision through the use of more advanced algorithms, which can be applied to accurately determine rotor shaft position and speed to eliminate the need for position/speed sensors in the system.

The Blackfin ADSP-BF50x series exemplifies the aforementioned trend toward greater on-chip integration of components. This integration includes high resolution ADCs for precise data conversion and modeling accuracy and integrated flash memory to further speed algorithm processing—both of which minimize off-chip components and lower overall system costs. Processors offering an optimal blend of performance and on-chip integration enable designers to realize a number of system-level design objectives, including real-time processing of more data, reduced latency, consolidation of processing tasks to a single processor, and greater flexibility to optimize system interface and control capabilities.

New technologies are pushing a paradigm shift in motor system capability, balancing design topologies and processor attributes to achieve greater overall system performance and efficiency. High performance DSPs enable modern control theory to be utilized in advanced system modeling, ensuring optimal power and control efficiency for any real-time motor system. The broad-based application of sensorless vector control is now within reach and promises to accelerate the global movement toward more energy efficient and high performance industrial equipment.

ADSP-BF50x Features

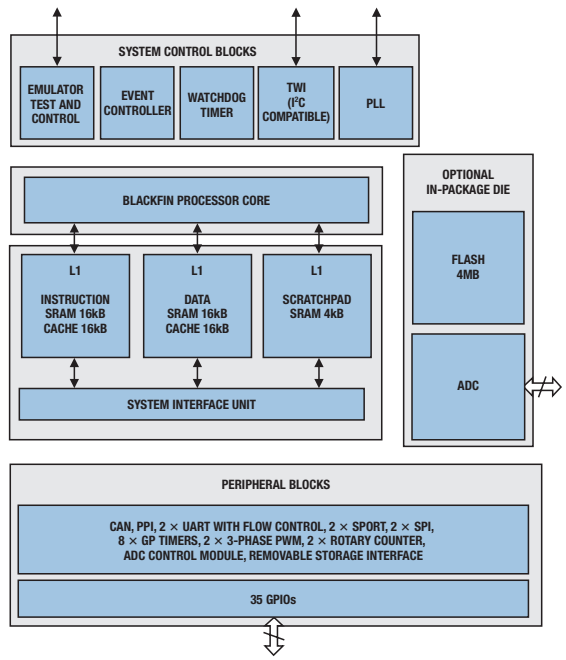
- 400 MHz LP process
- 4 MB flash (instructions and data)
- ADC dual SAR, 12 channels, 12 bits, up to 2 MSPS
- 2 UARTs, with flow control
- 2 SPORTs
- 2 SPIs
- 1 TWI (I²C®-compatible)
- Eight 32-bit GP timers
- 1 CAN
- 6 pair PWM unit (in addition to 8 timers with PWM)
- 35 GPIOs (muxed with interfaces)
- Two 32-bit up/down counters with rotary support
- Removable storage interface
- 1 PPI, up to 16 bits
- Operating temperature: –40°C to +85°C

Package Options

- 12 mm × 12 mm, 88-lead, 0.5 mm pitch LFCSP with single exposed paddle, no ADC
- 14 mm × 14 mm, 120-lead, 0.4 mm pitch LQFP with dual exposed paddles, with flash and ADC
- Pricing:
  - ADSP-BF504B—$5.18 to $12.78*

*Price is subject to change.

Blackfin ADSP-BF50x Processor Architecture


SYSTEM CONTROL BLOCKS
EMULATOR TEST AND CONTROL
EVENT CONTROLLER
WATCHDOG TIMER
TWI (I²C COMPATIBLE)
PLL
BLACKFIN PROCESSOR CORE
L1 INSTRUCTION SRAM 16kB CACHE 16kB
L1 DATA SRAM 16kB CACHE 16kB
L1 SCRATCHPAD SRAM 4kB
SYSTEM INTERFACE UNIT
OPTIONAL IN-PACKAGE DIE
FLASH 4MB
ADC
PERIPHERAL BLOCKS
CAN, PPI, 2 × UART WITH FLOW CONTROL, 2 × SPORT, 2 × SPI, 8 × GP TIMERS, 2 × 3-PHASE PWM, 2 × ROTARY COUNTER, ADC CONTROL MODULE, REMOVABLE STORAGE INTERFACE
35 GPIOs

Web-Based Tools

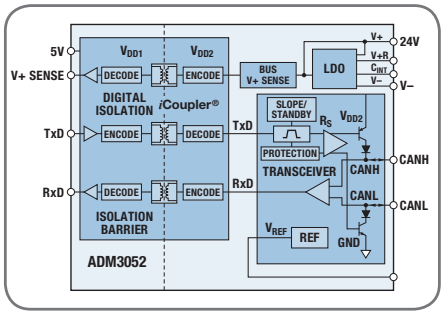
It has never been easier to add signal processing to your embedded design with low cost development tools, reference designs, 24/7 support at EngineerZone, on-demand training, free software, and more. For more information, visit *www.analog.com/blackfin50x*.

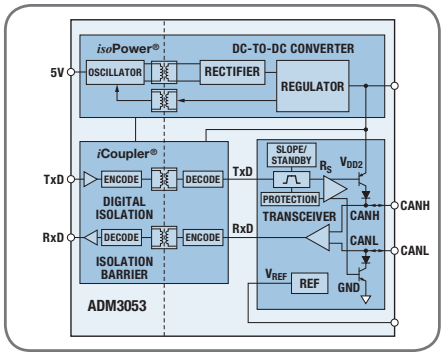
Integrated Signal and Power Isolated CAN Transceivers Deliver Quicker Time to Market in Industrial Fieldbus Communication Designs

Now, Analog Devices' ADM3052 and ADM3053 isolated CAN transceivers integrate the signal isolation and the power isolation with the CAN physical layer transceiver, in a small 10 mm × 10 mm area surface-mount, wide-body SOIC package (ADM3052 10 mm × 10 mm; ADM3053 10 mm × 13 mm).

The ADM3052 is ideal for applications where the 24 V is provided over the bus to power the bus-side circuitry through the integrated 24 V regulator. The other side of the 5 kV rms, UL 1577 rated, low power *i*Coupler® isolation barrier is powered from the local 3.3 V or 5 V power supply. Two channels of low power *i*Coupler isolation isolate the transmit and receive channels, while the third channel is used to isolate the V+ sense, 24 V, bus-power detection signal.

The ADM3053 is ideal for applications where all the power is provided from the local 5 V supply. The integrated *iso*Power isolated dc-to-dc converter provides an isolated 5 V supply to the bus-side circuitry of the ADM3053. Two channels of low power *i*Coupler isolation are used to isolate the transmit and receive channels.





Features

- ADM3052*
  - 5 kV rms *i*Coupler signal isolated RS-485/RS-422 transceiver
  - 11 V to 25 V LDO integrated on the bus-side for bus-powered applications
  - V+ sense function detects presence of 24 V power on the bus
  - 10 mm × 10 mm, 16-lead SOIC
  - Pricing: ADM3052—$3.00
- ADM3053*
  - Integrated 2.5 kV rms *iso*Power isolated dc-to-dc converter
  - Data rate: 1 Mbps
  - 5 V or 3.3 V operation on logic side
  - 110 nodes on bus
  - Integrated bus miswire protection
  - Temperature range: –40°C to +85°C
  - 10 mm × 13 mm, 20-lead SOIC
  - Pricing: ADM3053—$5.50

*This product is in sampling stage, with full production at a later date.
Samples can be obtained by visiting the product page on *www.analog.com*.

4-Channel, 1 kV rms Digital Isolator Available in Industry's Smallest Package: 5 mm × 6 mm QSOP

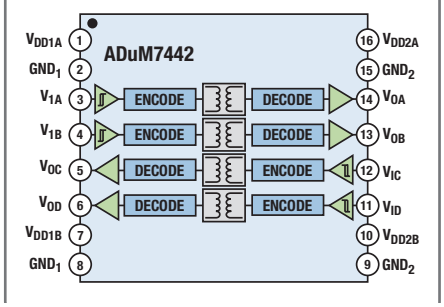
The ADuM744x family of *i*Coupler digital isolators provides the ideal replacement for optocouplers in a wide array of industrial applications. This product family delivers four channels of high speed isolation in a small, 16-lead QSOP surface-mount package. ADI's *i*Coupler technology, based on chip-scale transformers rather than on LEDs and photodiodes, supports higher data rates, consumes less power, and is more stable over its life as compared to LEDs and photodiodes. The ADuM744x products can support up to 1 kV rms transient surges for up to 1 minute per UL 1577. For applications requiring higher levels of isolation, ADI offers a family of products rated up to 5 kV rms that are the only digital isolators available today that meet the stringent IEC 60747-5-5 optocoupler standard for reinforced insulation.

*i*Coupler®

ADuM7440 Features

- 1000 V rms isolation rating
- Bidirectional communication
- Up to 25 Mbps data rate (NRZ)
- 5 mm × 6 mm, 16-lead QSOP
- Pricing:
  - ADuM7440 (4 forward/0 reverse channels)—$1.73
  - ADuM7441 (3 forward/1 reverse channels)—$1.50
  - ADuM7442 (2 forward/2 reverse channels)—$1.73

ADuM7442 Block Diagram



Applications

- General-purpose, multichannel isolation
- SPI interface/data converter isolation
- RS-232/RS-422/RS-485 transceivers
- Industrial fieldbus isolation

Precision Analog Microcontroller with Integrated ARM Cortex M3 and ISM Band Transceiver

The need to reduce development time, product size, device count, and product cost has become prevalent in many applications, including wireless applications such as wireless sensing.

Solution

The ADuCRF101 is a system-on-a-chip (SoC) solution, combining the industry-standard ARM® Cortex™ M3 core, ADI's high performance ISM radio transceiver technology, a 12-bit, multichannel 1 MSPS ADC, and additional peripherals in a single 9 mm × 9 mm package footprint.

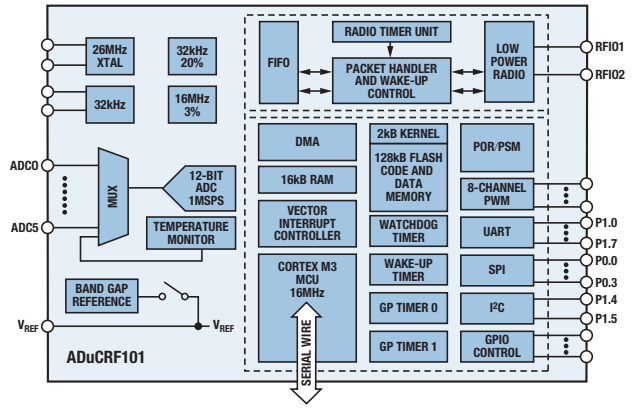
Combined with a comprehensive software ecosystem, the ADuCRF101 is an out of the box, low power, sub-1 GHz communication solution for wireless applications that require ease of use and rapid time to market.

ADuCRF101 Features*

- High performance transceiver
- 128 kB of Flash/EE memory, 16 kB of RAM
- Operates directly from 3.6 V battery
- Multichannel, 12-bit 1 MSPS ADC
- 9 mm × 9 mm, 64-lead LFCSP
- Pricing:
  - ADuCRF101—$4.49

*This product is in sampling stage, with full production at a later date. Samples can be obtained by visiting the product page on *www.analog.com*.

ADuCRF101 Block Diagram



Applications

- Smart metering
- Home automation
- Process building control
- Wireless sensor networks
- Wireless healthcare

ISM Band Transmitters and Transceivers Deliver Robust RF Performance for Short-Range Devices

Analog Devices' ADF7xxx series of transmitters and transceivers provides for low cost, robust, short-range wireless connections. Covering both licensed and unlicensed sub-1 GHz and 2.4 GHz frequency bands, these products feature excellent RF performance, low power consumption, and best-in-class blocking resistance, as well as high performance in terms of receive sensitivity, data rates, link robustness, and transmit power. These features make the ADF7xxx transmitters and transceivers ideal solutions for applications such as automatic meter reading (AMR), industrial automation, alarm and security systems, home automation systems, remote controls, and other wireless network and telemetry systems. Analog Devices has recently expanded its portfolio with three new devices.

- ADF7022
  - Sub-1 GHz transceiver
  - Support for io-homecontrol® protocol stack
- ADF7023
  - General-purpose FSK/GFSK sub-1 GHz transceiver
  - Supports up to 300 kbps with flexible packet structures
- ADF7242
  - 2.4 GHz transceiver
  - Delivers flexibility, ease of use and low current consumption

Applications

- General-purpose, multichannel isolation
- SPI interface/data converter isolation
- RS-232/RS-422/RS-485 transceivers
- Industrial fieldbus isolation

Web-Based Tools

The ADIsimSRD™ design tool allows real-time simulation of a typical short-range wireless system. Download your free copy at *www.analog.com/ADIsimSRD*.

Multichannel Simultaneous Sampling ADC Eases Complexities of Power-Line Monitoring Systems

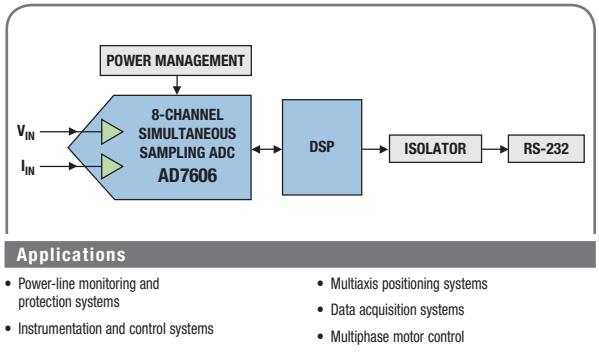
Designers of multichannel current and voltage monitoring systems deal with a complex host of circuit design challenges: dual supply requirements, limited analog input range, input impedance dependent on speed, and high costs due to implementation of expensive discrete components.

Solution

The AD7606 ADC simplifies substation automation design with its 8-channel, 16-bit, simultaneous sampling, true bipolar inputs. Integrating multiple channels enables the measurement of 3-phase current, voltage, and neutral monitoring for substation automation equipment. The ±5 V and ±10 V input ranges allow for the preservation of phase information while sampling bipolar voltages and currents over a wide dynamic range. The AD7606's bipolar input capability from a single 5 V supply, high impedance analog inputs, and on-board reference eliminate the need for external components and allow for single supply systems. The 16-bit AD7606 is available in 8-, 6-, and 4-channel versions; the AD7607 is a 14-bit, 8-channel version.

AD7606/AD7607 Features

- 7 kV tolerant analog inputs with overvoltage protection
- Incorporates input buffers with second-order antialias filtering
- On-chip digital filters to remove in-band noise
- Fast throughput rate: up to 200 kSPS per channel
- Low power: 100 mW typical at 200 kSPS
- 0.1% gain and 0.01% offset error
- 12 mm × 10 mm, 64-lead LQFP
- Pricing:
  - AD7606—$16.70
  - AD7607—$13.50



Applications

- Power-line monitoring and protection systems
- Instrumentation and control systems
- Multiaxis positioning systems
- Data acquisition systems
- Multiphase motor control

14-Bit to 16-Bit Multichannel and Simultaneous Sampling Precision ADCs

Part Number	Resolution (Bits)	Sample Rate (kSPS)	Channels	Analog Input Range (V)	DNL (LSB)	INL (LSB)	SNR (dB)	Package	Price ($U.S.)
AD7606	16	200	8 simultaneous sampling	±5, ±10	±0.99	±2	88.5	64-lead LQFP	16.70
AD7682	16	250	4	V_{REF}	–1, +1.5	±3	93	20-lead LFCSP	6.01
AD7689	16	250	8	V_{REF}	–1, +1.5	±3	93	20-lead LFCSP	5.99
AD7607	14	200	8 simultaneous sampling	±5, ±10	±0.5	±1	84.5	64-lead LQFP	13.50

*i*MEMS Microphones Offer High Audio Performance and Flexibility in Beamforming Applications

Analog Devices' *i*MEMS® analog and digital output microphones are ideally suited for multimicrophone security and surveillance applications, enhancing both audio acquisition and beamforming experiences. *i*MEMS microphones offer the industry's best SNR and extended frequency response, providing excellent sound quality and intelligibility for high definition voice/sound recognition. Tight part-to-part tolerances enhance beamforming directivity while superior PSRR and small package size provide designers with maximum flexibility in placement of microphones.

***i*MEMS Microphones**

Part Number	Output	Sensitivity	SNR (dB A-Weighted)	Frequency Response	PSRR	Package Size (mm)	Price ($U.S.)
ADMP401	Analog	–42 dBV	62	Flat 100 Hz to 15 kHz	70 dBV	4.72 × 3.76 × 1.00	1.63
ADMP404	Analog	–38 dBV	62	Flat 100 Hz to 15 kHz	70 dBV	2.50 × 3.35 × 0.88	1.79
ADMP405	Analog	–38 dBV	62	Flat 200 Hz to 15 kHz	70 dBV	2.50 × 3.35 × 0.88	1.79
ADMP421	Digital	–26 dBFS	61	Flat 100 Hz to 15 kHz	80 dBFS	3.00 × 4.00 × 1.00	2.04

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East Bridgewater, MA 02333-1122

Tested Circuit Designs Allow for Quick and Easy System Integration

Circuits from the **Lab**™

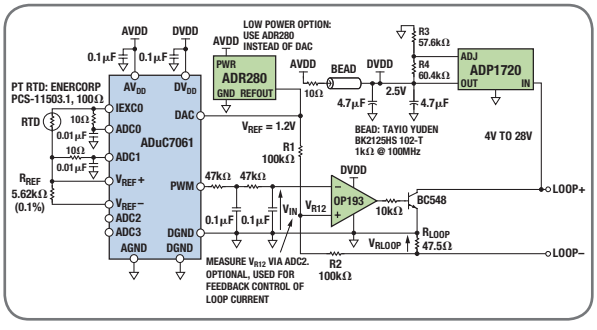
Analog Devices' Circuits from the Lab™ are tested circuit designs that address common design challenges and have been engineered for quick and easy system integration. They are designed to help engineers manage the increased time pressure they face to complete designs by providing tested building blocks that are easy to understand and integrate into a design.

Circuit note documentation describes the circuit's function and benefits, theory of operation, test data, and design/layout guidelines. Newer circuits also contain schematic files, PCB layout files, a bill of materials, and a device driver (when applicable). Several new circuits are also available as low cost evaluation boards. Learn more at *www.analog.com/circuits*.

Featured Circuits from the Lab

Circuit Note CN-0145, *4 mA to 20 mA Loop-Powered Temperature Monitor Using a Precision Analog Microcontroller*

This circuit represents the most cost-effective, lowest power, lowest board area solution compared to using discrete ADCs and a separate microcontroller. Because of its high level of integration and low power, the ADuC7060/ADuC7061 precision analog microcontroller can operate directly from the loop power in the 4 mA to 20 mA application. On-chip functionality includes dual 24-bit Σ-Δ ADCs, the ARM7 processor core, and the DAC/PWM features for controlling the 4 mA to 20 mA feedback circuit. For access to this circuit note, visit *www.analog.com/CN0145*.



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All prices in this bulletin are in USD in quantities greater than 1000 (unless otherwise noted), recommended lowest grade resale, FOB U.S.A.

All products featured in this bulletin are full production released and available to order from ADI or its authorized distributors (unless otherwise noted).

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

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